Independent Performance Evaluation of Biometric Systems:

Minutiae Performance versus Pseudonymous Identifier Performance

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FP7 Integrated Project TURBINE (TrUsted Revocable Biometric IdeNtitiEs)

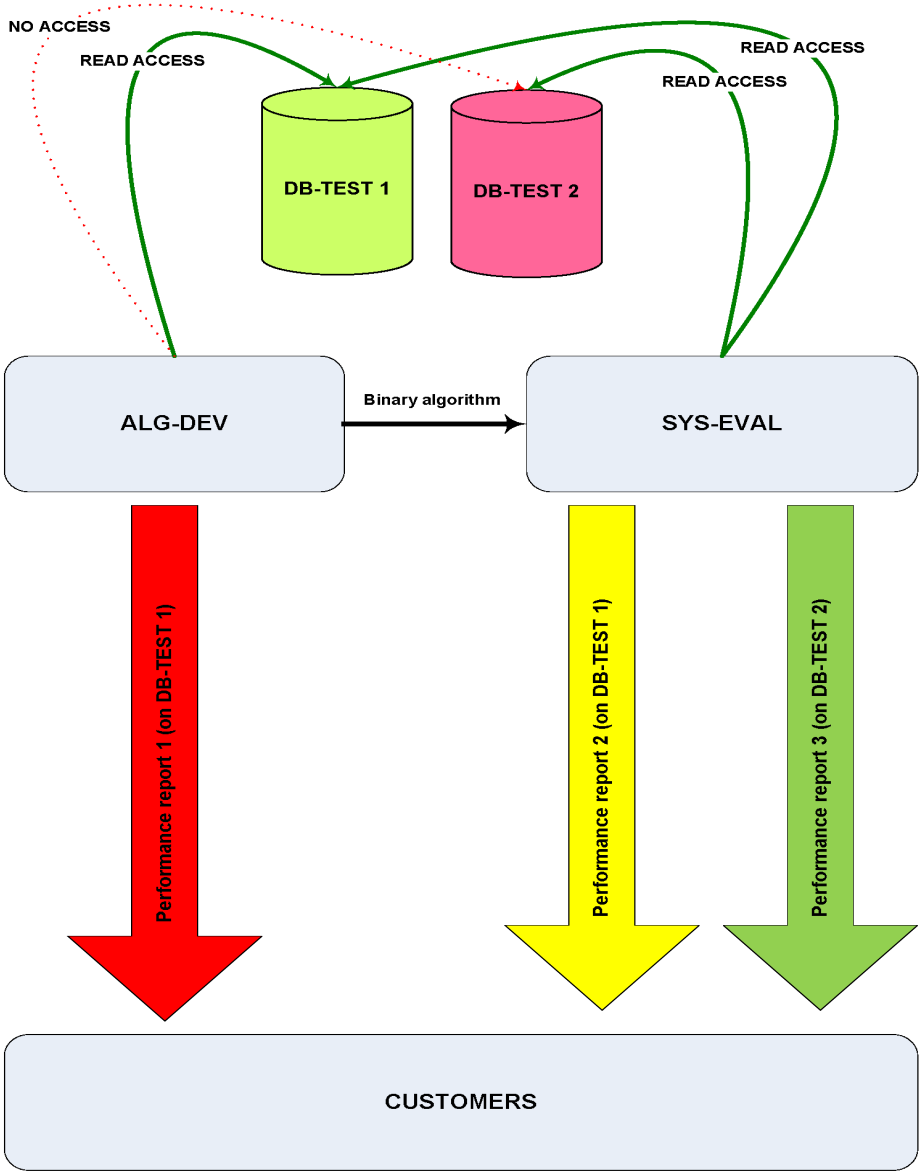
Overview

- Biometric performance evaluation
- TURBINE project
- Performance metrics, data set and results
- Summary

Biometric Performance Evaluation

- Test database
- Algorithm developer
- Performance evaluator
- Test report(s)

Biometric Performance Test Reports



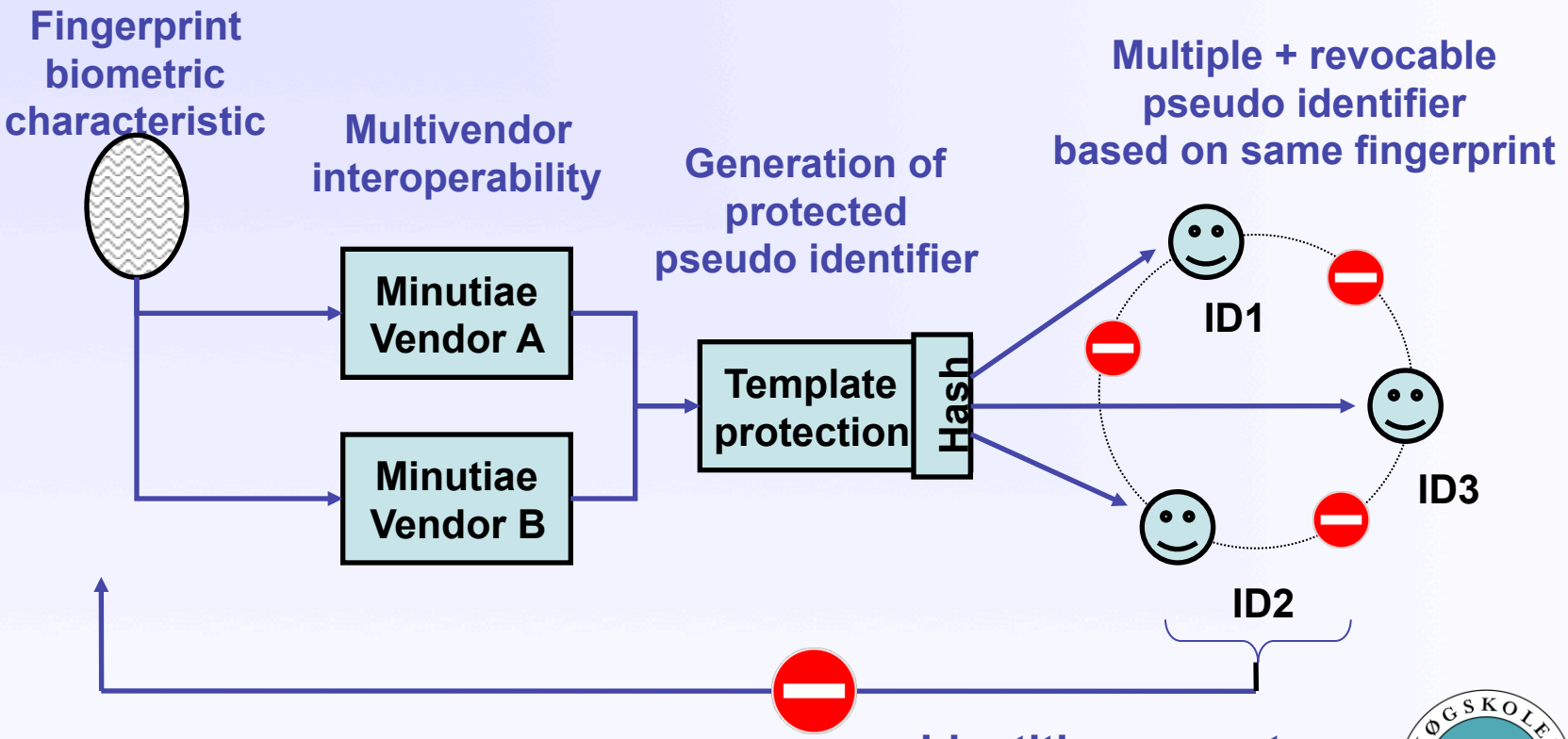
- **Least trustable - Report 1 (on DB 1)**
- **Medium trustable - Report 2 (on DB 1)**
- **Most trustable - Report 3 (on DB 2)**

TURBINE

- TURBINE – TrUsted Revocable Biometric IdeNtitiEs
- EU FP7 project, http://www.turbine-project.eu
- Two rounds of performance evaluation
- In this paper/presentation
  - **This is 1st round results (not final!)**
  - Performance report ”Category 3”
  - Only ”biometric performance/analysis” per se
  - Not ”security performance/analysis”

Main Objectives and Principles

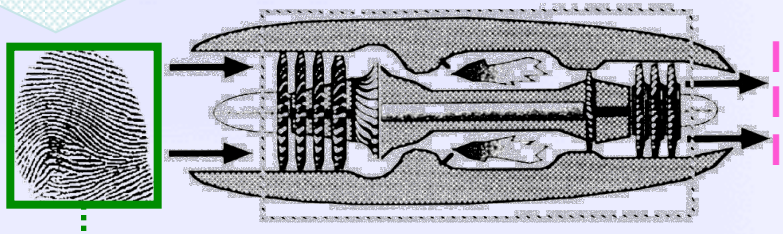
- Solutions: software-based, hardware-based, or both
- In general, it requires:



Impact

Name : SMITH
Date of birth: …
Identity managed by issuance State, including biometrics, certificates & data protection mechanism

Mr SMITH +



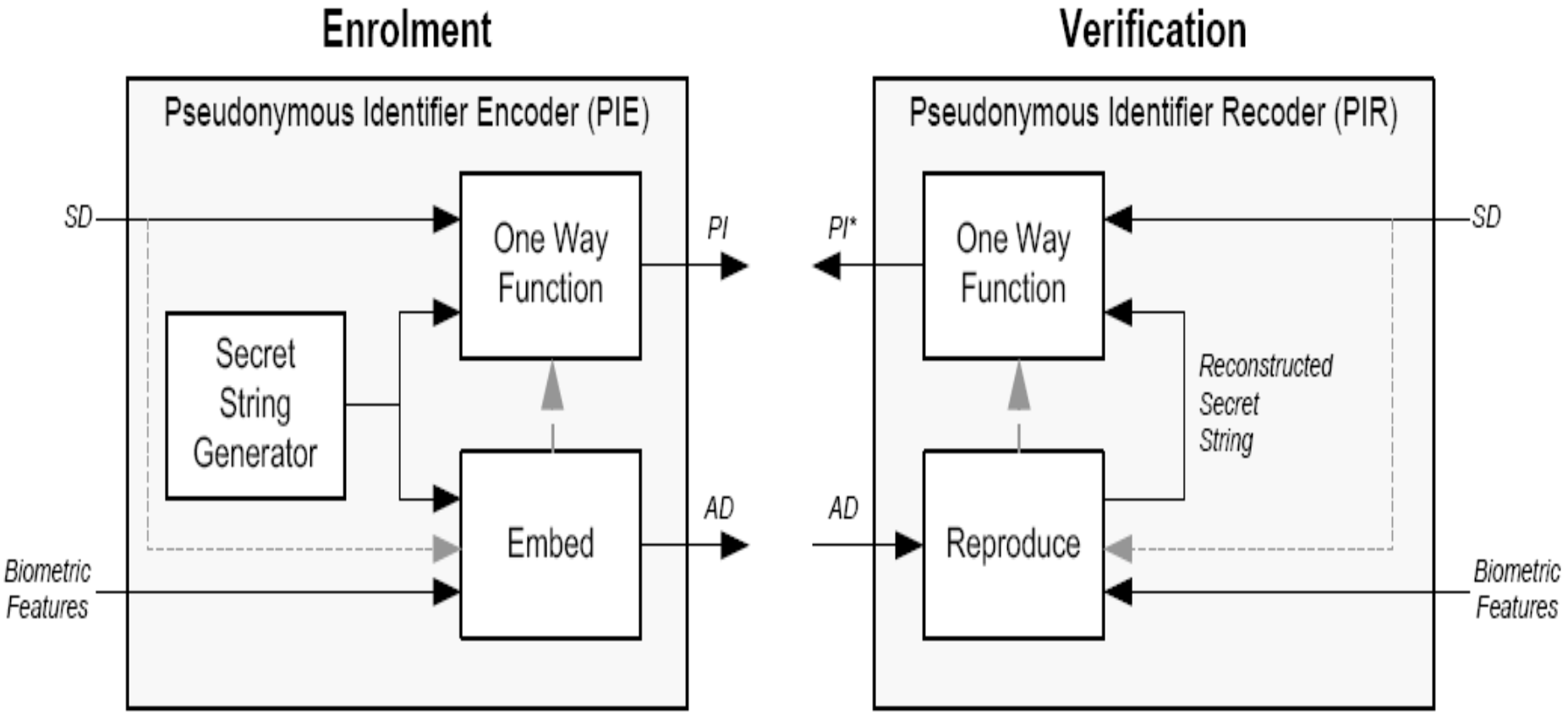
ID1 + 101 011 101 011 110 0011 01
ID2 + 101 101 110 101 110 1010 10
ID3 + 110 011 011 101 101 0110 10

TURBINE

IMPACT on "ID" verification

- Different identities (pseudo, voter, tax payer, …) derivate from a trusted identity
- Trust the token holder true his fingerprint
- Fingerprint is transformed & substituted instead of encrypted ➔ privacy impact
- Revocation without impact on the original fingerprint

Pseudo Identifier Encoder in ISO 24745 (2nd CD)



TURBINE

- Algorithm developers
  - Sagem Sécurité (France)
  - Precise Biometrics AB (Sweden)
  - Philips Research Europe (The Netherlands)
  - University of Twente (The Netherlands)
- Biometric performance evaluator
  - Gjøvik University College (Norway)
- Security performance evaluator
  - K.U.Leuven (ICRI, COSIC) (Belgium)

Test database

- GUC100
  - 6 scanners,
  - 100 subjects, all 10 fingers
  - ~ 72000 images

Test database (II)

- Temperature variation (Norway 2008/09)
- 12 sessions (on separate days)
  - Uncontrolled
    - No image quality control
  - Controlled
    - Quality was controlled to some extend visually (e.g. by wetting fingers if necessary)
- Sequestered database - No access granted to algorithm developers

Performance metrics

- Algorithm performance
  - FMR vs. FNMR
- System performance
  - FAR vs. FRR
- Formulas
  - FAR = FMR*(1-FTA)
  - FRR = FNMR*(1-FTA) + FTA
  - **FTA = FTC + FTX*(1-FTC)**

$$FTX = \frac{\#-of-not-encoded-images}{total-\#-of-images-submitted-to-encoder}$$

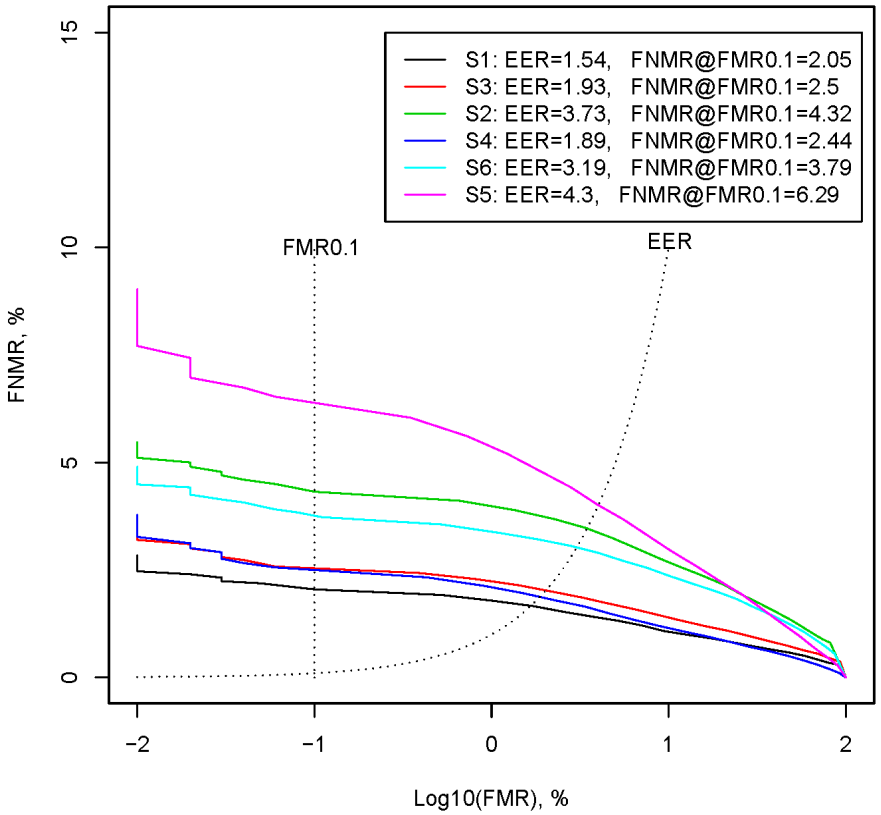
Performance metrics (II)

- Minutiae level (classical)
  - Without considering image quality
  - With image quality (NFIQ > 3 count in FTC)
- Pseudonymous Identifier (PI) level
  - Large throughput
  - Less points in DET curves
- DET curves
  - Scanner and software suppliers are anonymous

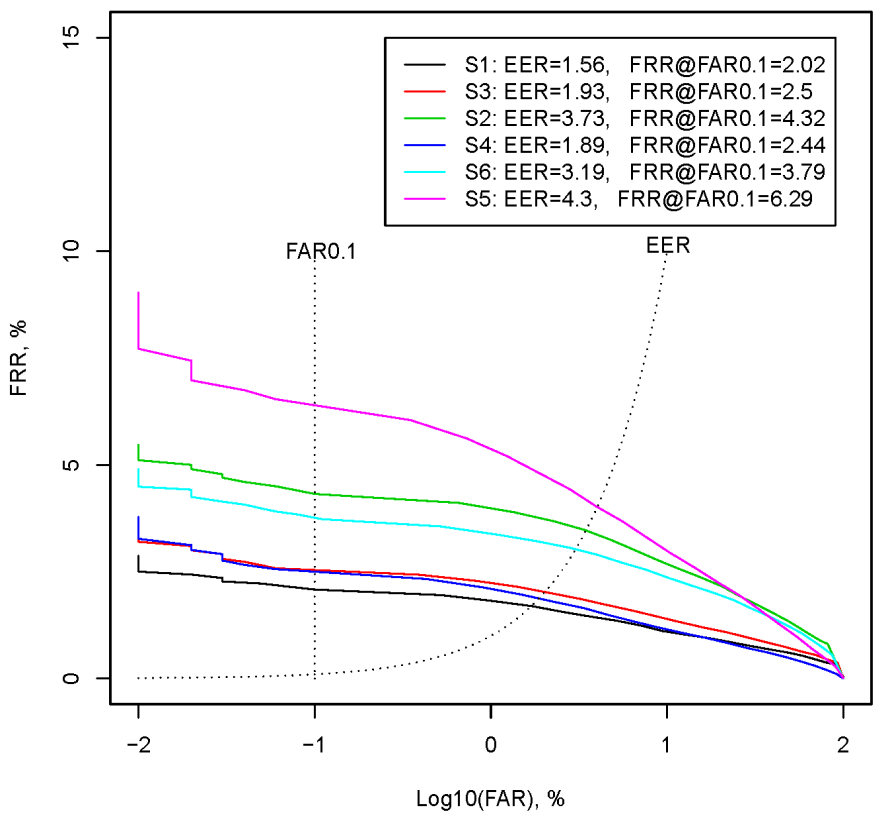
Minutiae level:

Neurotechnology without considering image quality

Algorithm performance



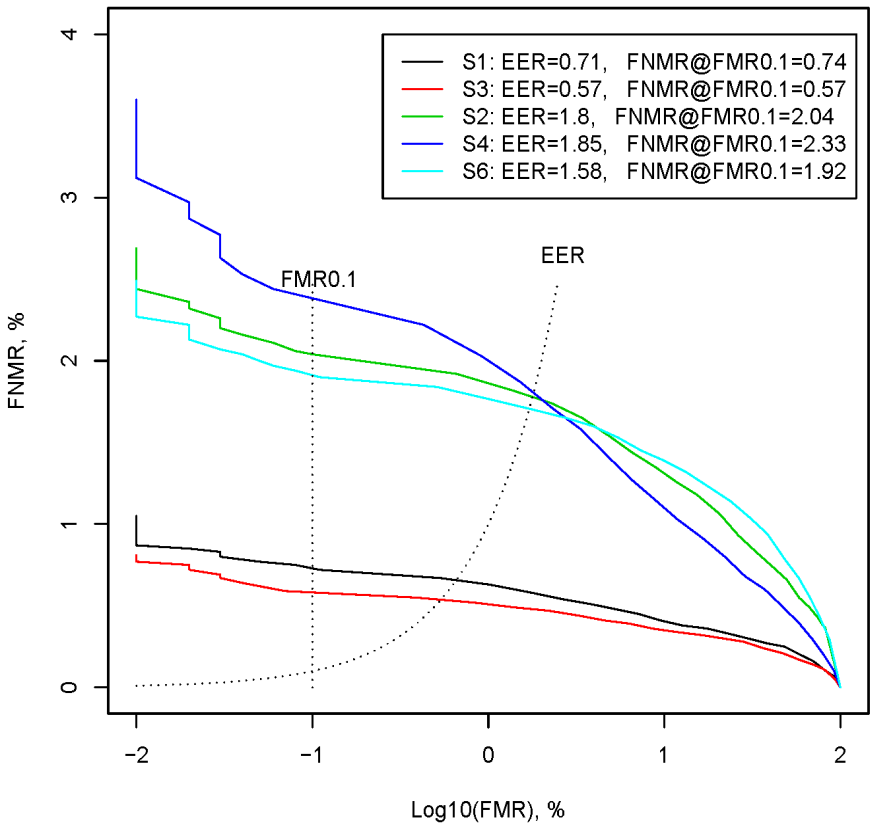
System performance



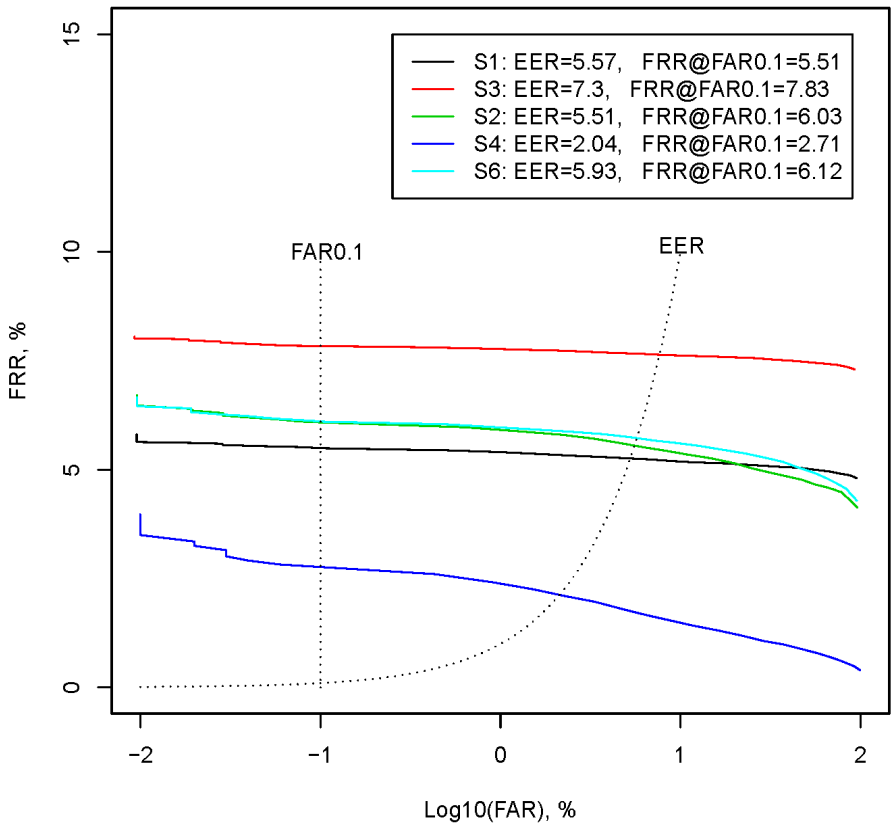
Minutiae level:

Neurotechnology with considering image quality

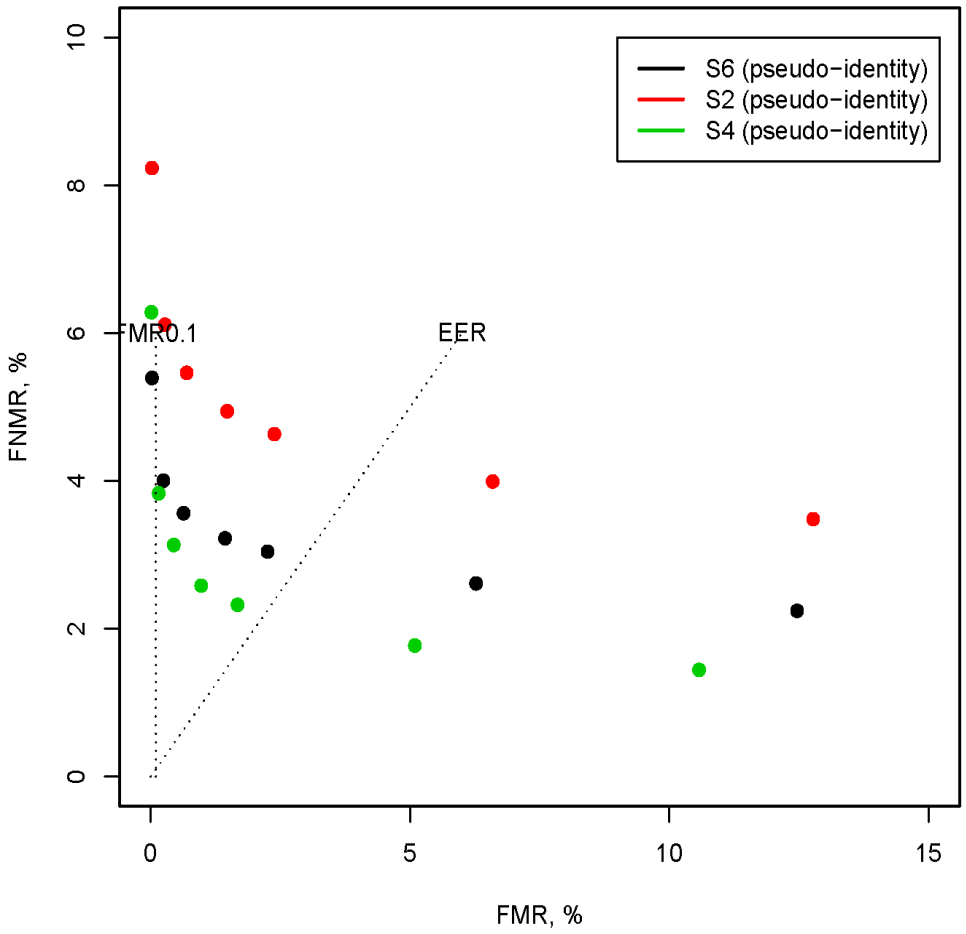
Algorithm performance



System performance

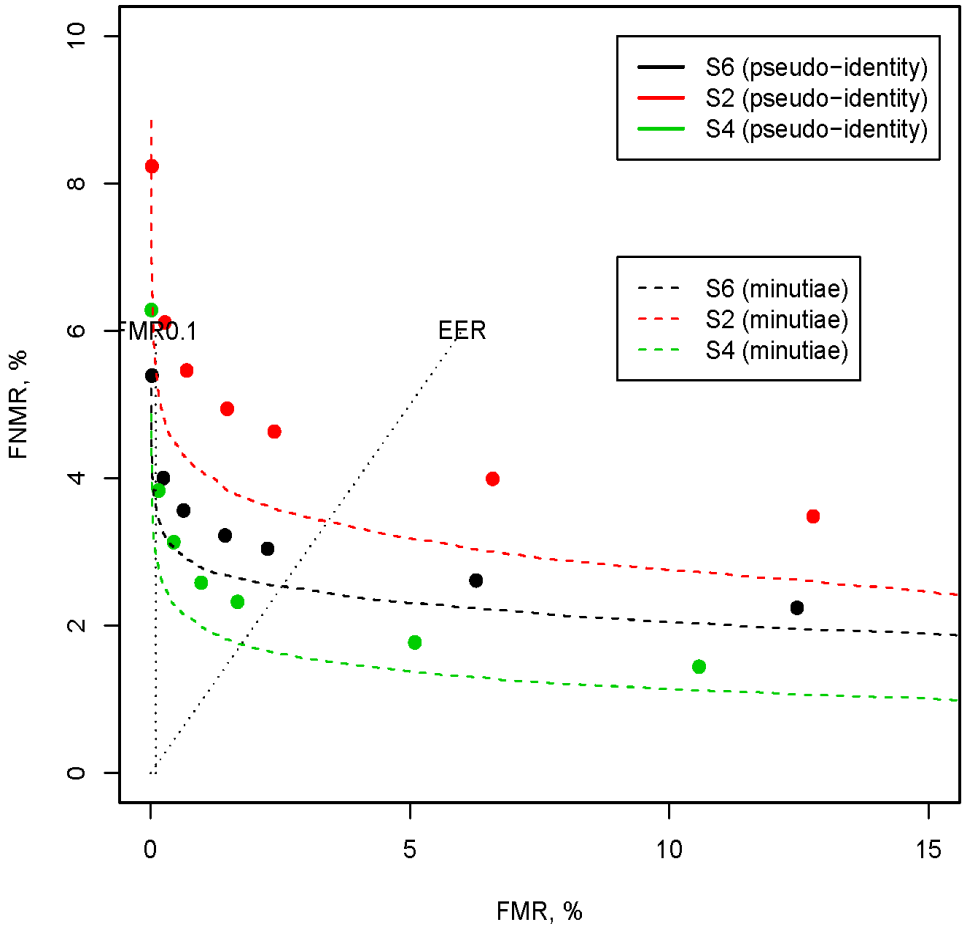


PI level: Supplier A



- One example of a PI algorithm.
- Only a biometric performance (no assessment on the security).
- Disclaimer: other algorithms have also been tested in the benchmark, and the security analysis is still ongoing (results subject to the research by Koen Simoens)

PI vs. Minutiae level: Supplier A



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Summary and future work

- Desirably ”Developers” and ”Evaluators” to be independent entities
- PI level verification aims to provide more gain with respect to privacy, although there might be some degradation of performance
- Security analysis must also be taken into account
- 2nd round of tests in TURBINE in second half of year 2010, and the results in year 2011

Acknowledgment

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